CLAIMS

What is claimed is:

1. A method of embedding a watermark bit-sequence in a data stream of symbols compressed using dictionary-based compression scheme with variable length indices, comprising:

receiving a request to transmit an index value from a set of m-bit index values used to compress one or more symbols in the data stream;

identifying divisions in the set of m-bit index values including a non-watermark value range, a zero-bit watermark value range and a one-bit watermark value range;

determining a watermark bit value corresponding to the watermark bit sequence as either a zero-bit value or a one-bit value;

transmitting the index value in the one-bit watermark value range when the watermark bit value is determined to be a one-bit value; and

transmitting the index value in the zero-bit watermark value range when the watermark bit value is determined to be a zero-bit value.

2. The method of claim 1 further comprising:

transmitting the index value without watermark embedding when the index belongs to the non-watermark value range.

3. The method of claim 1 wherein the symbols are compressed losslessly utilizing one or more variants of the Lempel-Ziv (LZ) family of lossless data compression schemes.

4. The method of claim 1 wherein an index in the non-watermark value range does not carry a watermark bit value and occupies a lower range of values from a set of m-bit index

values.

5. The method of claim 4 wherein the lower range of values corresponds to a set of indices substantially below a watermark threshold (w_t).

6. The method of claim 4 wherein the watermark threshold (w_t) corresponds to a maximum index entry (c_t) less a maximum value using m-bits of data.

7. The method of claim 1 wherein the zero-bit watermark value range is substantially greater than the watermark threshold (w_t) and substantially less than the maximum index entry (c_t).

8. The method of claim 1 wherein the one-bit watermark value range is substantially greater than the maximum index entry (c_t) and substantially less than a maximum value using m-bits of data.

9. The method of claim 1 wherein transmitting the index in the one-bit watermark value range includes:

identifying the requested index value in the zero-bit watermark value range; and

adding a watermark delta value to the index value in the zero-bit watermark value range to identify a symmetric entry in the one-bit watermark value range.

10. The method of claim 8 wherein the watermark delta value corresponds to a maximum value using m-bits of data less at least a maximum index entry (c_t).

11. The method of claim 1 wherein transmitting the index in the zero-bit watermark value range includes:

identifying the requested index value in the zero-bit watermark value range.

12. The method of claim 1 further comprising:

receiving a preexisting compressed data stream not configured to support an embedded watermark bit-sequence;

partially decompressing the preexisting compressed data stream of symbols; and

reconstructing the data stream of symbols with indices that embed the watermark bit-sequence.

13. The method of claim 12 wherein the preexisting compressed data stream is compatible with the GIF compression format.

14. A method of extracting a watermark bit-sequence from a data stream of symbols compressed using a dictionary-based compression scheme with variable length indices, comprising:

identifying the divisions for a non-watermark value range, a zero-bit watermark value range and a one-bit watermark value range within a set of m-bit index values;

receiving an input index value potentially having an embedded watermark value;

classifying the input index value as a member of one of the divisions within the set of m-bit index values;

setting a next bit of the watermark bit-sequence to a zero value when the input index value is in the zero-bit watermark value range; and

setting a next bit of the watermark bit-sequence to a one value when the input index value is in the one-bit watermark value range.

15. The method of claim 14 wherein the watermark bit-sequence extracted can be used as a fragile watermark to identify if the compressed data stream of symbols have been altered.

16. The method of claim 14 further comprising:

receiving no watermark value when the index value is in the non-watermark value range.

17. The method of claim 14 wherein the symbols are decompressed losslessly utilizing one or more variants of the Lempel-Ziv (LZ) family of lossless data compression schemes.

18. The method of claim 14 wherein an index in the non-watermark value range does not carry a watermark bit value and occupies a lower range of values from a set of m-bit index values.

19. The method of claim 18 wherein the lower range of values corresponds to a set of indices substantially below a watermark threshold (w_t).

20. The method of claim 19 wherein the watermark threshold (w_t) corresponds to a maximum index entry (c_t) less a maximum value using m-bits of data.

21. The method of claim 14 wherein the zero-bit watermark value range is substantially greater than the watermark threshold (w_t) and substantially less than the maximum index entry (c_t).

22. The method of claim 14 wherein the one-bit watermark value range is substantially greater than the maximum index entry (c_t) and substantially less than a maximum value using m-bits of data.

23. The method of claim 14 wherein setting the next bit of the watermark bit-sequence to a one value further comprises:

subtracting a watermark delta value to the index value in the one-bit watermark value range to identify a symmetric entry in the zero-bit watermark value range; and

setting an index representing a compressed string to the index identified in the zero-

bit watermark value range.

24. The method of claim 23 wherein the watermark delta value corresponds to a maximum value using m-bits of data less at least a maximum index entry (c_t).

25. The method of claim 14 wherein setting the next bit of the watermark bit-sequence to a zero value further comprises:

setting an index representing a symbol to the index identified in the zero-bit watermark value range.

9526. A computer program product for embedding a watermark bit-sequence in a data stream of symbols compressed using dictionary-based compression scheme with variable length indices, tangibly stored on a computer-readable medium, comprising instructions operable to cause a programmable processor to:

receive a request to transmit an index value from a set of m-bit index values used to compress one or more symbols in the data stream;

identify divisions in the set of m-bit index values including a non-watermark value range, a zero-bit watermark value range and a one-bit watermark value range;

determine a watermark bit value corresponding to the watermark bit sequence as either a zero-bit value or a one-bit value;

transmit the index value in the one-bit watermark value range when the watermark bit value is determined to be a one-bit value; and

transmit the index value in the zero-bit watermark value range when the watermark bit value is determined to be a zero-bit value.

27. The computer program product of claim 26 further comprising instructions when

executed:

transmit the index value without watermark embedding when the index belongs to the non-watermark value range.

28. The computer program product of claim 26 wherein the symbols are compressed losslessly utilizing one or more variants of the Lempel-Ziv (LZ) family of lossless data compression schemes.

29. The computer program product of claim 26 wherein an index in the non-watermark value range does not carry a watermark bit value and occupies a lower range of values from a set of m-bit index values.

30. The computer program product of claim 29 wherein the lower range of values corresponds to a set of indices substantially below a watermark threshold (w_t).

31. The computer program product of claim 30 wherein the watermark threshold (w_t) corresponds to a maximum index entry (c_t) less a maximum value using m-bits of data.

32. The computer program product of claim 26 wherein the zero-bit watermark value range is substantially greater than the watermark threshold (w_t) and substantially less than the maximum index entry (c_t).

33. The computer program product of claim 26 wherein the one-bit watermark value range is substantially greater than the maximum index entry (c_t) and substantially less than a maximum value using m-bits of data.

34. The computer program product of claim 26 wherein instructions for transmitting the index in the one-bit watermark value range includes further comprise instructions when executed that:

identify the requested index value in the zero-bit watermark value range; and

add a watermark delta value to the index value in the zero-bit watermark value range to identify a symmetric entry in the one-bit watermark value range.

35. The computer program product of claim 34 wherein the watermark delta value corresponds to a maximum value using m-bits of data less at least a maximum index entry (c_t).

36. The computer program product of claim 26 wherein instructions for transmitting the index in the zero-bit watermark value range further comprises instructions when executed that:

identify the requested index value in the zero-bit watermark value range.

37. The computer program product of claim 26 further comprising instructions to:

receive a preexisting compressed data stream not configured to support an embedded watermark bit-sequence;

partially decompress the preexisting compressed data stream of symbols; and

reconstruct the data stream of symbols with indices that embed the watermark bit-sequence.

38. The computer program product of claim 37 wherein the preexisting compressed data stream is compatible with the GIF compression format.

39. A computer program product for extracting a watermark bit-sequence from a data stream of symbols compressed using a dictionary-based compression scheme with variable length indices, tangibly stored on a computer-readable medium, comprising instructions operable to cause a programmable processor to:

identify the divisions for a non-watermark value range, a zero-bit watermark value range and a one-bit watermark value range within a set of m-bit index values;

receive an input index value potentially having an embedded watermark value;

classify the input index value as a member of one of the divisions within the set of m-bit index values;

set a next bit of the watermark bit-sequence to a zero value when the input index value is in the zero-bit watermark value range; and

set a next bit of the watermark bit-sequence to a one value when the input index value is in the one-bit watermark value range.

40. The computer program product of claim 39 wherein the watermark bit-sequence extracted can be used as a fragile watermark to identify if the compressed data stream of symbols have been altered.

41. The computer program product of claim 39 further comprising:

receiving no watermark value when the index value is in the non-watermark value range.

42. The computer program product of claim 39 wherein the symbols are decompressed losslessly utilizing one or more variants of the Lempel-Ziv (LZ) family of lossless data compression schemes.

43. The computer program product of claim 39 wherein an index in the non-watermark value range does not carry a watermark bit value and occupies a lower range of values from a set of m-bit index values.

44. The computer program product of claim 43 wherein the lower range of values corresponds to a set of indices substantially below a watermark threshold (w_t).

45. The computer program product of claim 44 wherein the watermark threshold (w_t) corresponds to a maximum index entry (c_t) less a maximum value using m-bits of data.

46. The computer program product of claim 39 wherein the zero-bit watermark value range is substantially greater than the watermark threshold (w_t) and substantially less than the maximum

index entry (c_t).

47. The computer program product of claim 39 wherein the one-bit watermark value range is substantially greater than the maximum index entry (c_t) and substantially less than a maximum value using m-bits of data.

48. The computer program product of claim 39 wherein instructions that set the next bit of the watermark bit-sequence to a one value further comprises instructions that:

subtract a watermark delta value to the index value in the one-bit watermark value range to identify a symmetric entry in the zero-bit watermark value range; and

set an index representing a symbol to the index identified in the zero-bit watermark value range.

49. The computer program product of claim 48 wherein the watermark delta value corresponds to a maximum value using m-bits of data less at least a maximum index entry (c_t).

50. The computer program product of claim 39 wherein setting the next bit of the watermark bit-sequence to a zero value further comprises instructions that:

set an index representing a symbol to the index identified in the zero-bit watermark value range.

51. An appartus for embedding a watermark bit-sequence in a data stream of symbols compressed using dictionary-based compression scheme with variable length indices, comprising:

means for receiving a request to transmit an index value from a set of m-bit index values used to compress one or more symbols in the data stream;

means for identifying divisions in the set of m-bit index values including a non-watermark value range, a zero-bit watermark value range and a one-bit watermark value range;

means for determining a watermark bit value corresponding to the watermark bit sequence as either a zero-bit value or a one-bit value;

means for transmitting the index value in the one-bit watermark value range when the watermark bit value is determined to be a one-bit value; and

means for transmitting the index value in the zero-bit watermark value range when the watermark bit value is determined to be a zero-bit value.

52. An apparatus for extracting a watermark bit-sequence from a data stream of symbols compressed using a dictionary-based compression scheme with variable length indices, comprising:

means for identifying the divisions for a non-watermark value range, a zero-bit watermark value range and a one-bit watermark value range within a set of m-bit index values;

means for receiving an input index value potentially having an embedded watermark value;

means for classifying the input index value as a member of one of the divisions within the set of m-bit index values;

means for setting a next bit of the watermark bit-sequence to a zero value when the input index value is in the zero-bit watermark value range; and

means for setting a next bit of the watermark bit-sequence to a one value when the input index value is in the one-bit watermark value range.